MISSOURI resources

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director's comment

Missouri is fortunate to be blessed with many high-quality streams and lakes. In fact, several of our streams have been designated as national scenic rivers. Clean water is essential to everything we do; it is vital for our health, communities, environment and economy.

However, Missouri and the nation have not always been blessed with pristine waters. Many of our streams that currently serve as a source for drinking water or recreation were once used as a waste stream, collecting unwanted trash, sewage and dangerous wastes. The Cuyahoga River in Ohio was the most notable example of a waterbody that was so severely damaged that it periodically caught fire due to the pollutants it received. Sources have suggested that in 1972, only one-third of the nation's waters were safe for fishing and swimming.

Thankfully, however, the people and Congress took necessary action to address the widespread pollution and reduce the significant health threats from polluted waters flowing through our communities and backyards. On Oct. 18, 1972, the Clean Water Act became a federal law set forth to protect U.S. water quality.

States and communities have been working to improve and protect our watersheds during the last 40 years. While we have made great strides in reducing the pollution, we certainly understand that we continue to face many challenges and must continue to work together to protect clean water for ourselves, our families and future generations.

To help with this effort, the department is developing a new watershed-based approach to manage the state's water resources through – Our Missouri Waters. This statewide initiative will streamline the department's watershed planning efforts while increasing public engagement, better targeting and utilizing resources and providing greater benefit in protecting Our Missouri Waters.

Stakeholders, partnering agencies and the public will play a critical role throughout the Our Missouri Waters initiative and can help make a difference. This exciting and innovative initiative is featured in this issue of Missouri Resources. *We also welcome you to learn more and see how you can become involved by visiting the department's website at dnr.mo.gov. Together, we will ensure Missouri's abundant and treasured water resources will continue to provide a valuable quality of life for generations to come.*

Sara Parker Pauley
Missouri Department of Natural Resources

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Mission Statement
The mission of the Missouri Department of Natural Resources
is to protect, preserve and enhance Missouri's natural, cultural and energy resources.

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MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Above: The new Kelley Branch Mountain Bike Trail gives visitors another popular recreational opportunity at Finger Lakes State Park near Columbia.
Cover: The waters of Ha Ha Tonka Spring reflect the surrounding foliage at Ha Ha Tonka State Park near Camdenton.
DNR photos by Scott Myers.

Our Missouri Waters

by Darrick Steen and Renee Bungart
photographs by Scott Myers

Bluffs overlook the Big River at St. Francois State Park near Bonne Terre – part of the Big River watershed.

Our Missouri waters are as diverse as the very landscapes they flow through. From the rolling farmlands of the north to the Ozark hills of the south; from the Mississippi River bottoms of the east to the open prairies of the west, Missouri is blessed with natural diversity like no other state in the nation. Missouri's flowing waterways and lakes, from our "big muddy" Missouri River to our crystal clear spring-fed streams in the south are all interconnected to the high quality of life in Missouri and play a major role in the state's overall health and economic well-being.

We depend on good quality water for drinking; we depend on an abundance of water for agriculture and industrial purposes. We depend on good quality water to support the aquatic life living in our streams and lakes. We certainly want to be surrounded by clean, pristine rivers and lakes when we are swimming, canoeing, boating and playing in our waters during recreational seasons.

In order to protect Missouri's and the nation's water quality, Congress passed the federal Clean Water Act in 1972. The basis of the Clean Water Act was first enacted in 1948 and was called the Federal Water Pollution Control Act. It was significantly reorganized and expanded in 1972.

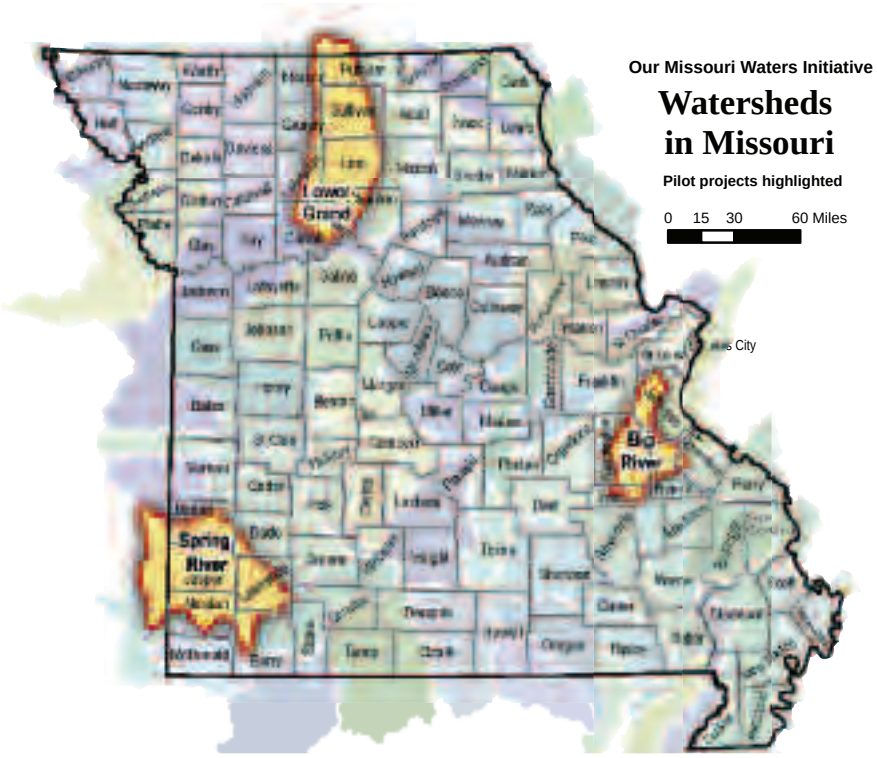
The various state and federal Clean Water Act programs have made significant improvements to our state's water quality and have achieved important reductions in pollutant discharges to our rivers, lakes and streams. During this time period, the work of protecting and managing water resources has been addressed in a more traditional

(Left) The Lower Grand River watershed is predominantly rural, with most of the land used for agriculture.
(Bottom) The Big River in Washington State Park, near De Soto, is a popular place to escape the heat during one of Missouri's hottest summers on record.

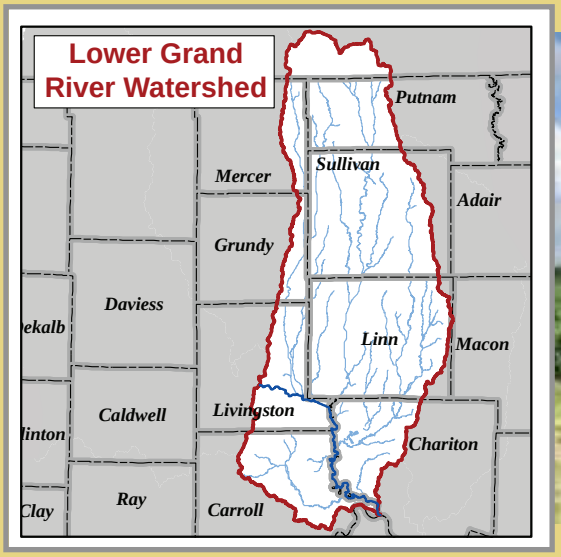
manner through permitting, inspections and enforcement actions to control point source pollution. Point source pollution refers to water pollution that comes from a specific, identifiable source, such as a drainage pipe, channel or lagoon.

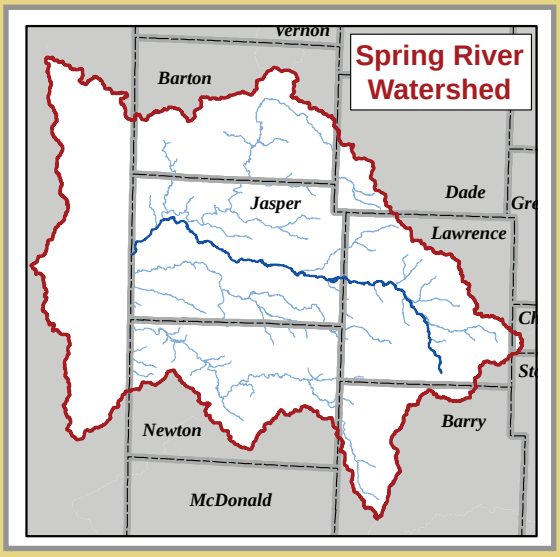
Attaining cost-effective and measurable improvements in the future will require a new approach – one that looks at watersheds holistically and encourages communities to look at all potential sources of water pollution, beyond standard point source contributors. The Missouri Department of Natural Resources decided to take a step back from the traditional approach and reprioritize Missouri's watershed management to create that coordinated, holistic approach to protecting water quality and preserving our Missouri waters. The department established a Watershed Advisory Committee that will offer its expertise and insight to the department as it works to develop, implement and evaluate this new approach. The department is creating the framework to integrate all appropriate department resources and programs in a given watershed when addressing the water resource management needs. This will maximize our efficiencies, resources and environmental benefits for the state. Of course, there was no better name for this new, innovative statewide watershed approach than to call it – Our Missouri Waters.

We've named this initiative Our Missouri Waters because water, like all of our natural resources, belongs to all of us. We all need to understand and be vested in protecting our waters to ensure a positive future, and DNR needs your input in order for this effort to be beneficial and successful. By



OMW – Pilot Phase





The Missouri Department of Natural Resources selected three pilot watersheds to be included in the first phase of the Our Missouri Waters initiative. The department evaluated all watersheds throughout the state and selected Spring River watershed, Big River watershed and the Lower Grand River watershed, due to their diversity and opportunities. When selecting the three pilot watersheds, the department examined issues such as water quality, water quantity, high-quality waters for preservation and local stakeholder interest.

The department began implementing the pilot projects in early 2012 and will continue the planning process into 2013. These pilots will allow the department to analyze how well this watershed-based approach works and to make adjustments before implementing a statewide effort expected to be launched in 2013.

The bottomlands of the Lower Grand River watershed are some of the most fertile in the state.

working directly with citizens, stakeholder groups, communities, industries, and local leaders, by providing cost share programs to farmers, and providing financial assistance to communities and cities, we can employ many effective tools and resources to better manage and preserve Missouri's great watersheds.

Missouri's landscape and culture is diverse and unique, perhaps like no other state in the nation, certainly within this region. With the diverse hydrologic and multi-water-related resources to manage, it makes sense to be able to tailor our activities to the unique challenges and opportunities specific to each watershed region.

One of the keys to this approach will be viewing, monitoring, analyzing and, in turn, managing our water resources at the local watershed level – where specific water resource management needs are best addressed. The watershed-based approach will also allow a common

understanding of the roles, priorities and responsibilities of all stakeholders within a watershed. This approach is based on the concept that many of our water resource concerns, like water quality, water quantity, and source water protection, are better evaluated and addressed collectively at the watershed level.

Implementing a watershed approach into department processes complements and allows better coordination of other local, state and federal water resource activities. Support of a watershed approach represents awareness that restoring and maintaining our waters requires crossing traditional barriers (point vs. nonpoint sources of pollution) and a willingness to explore new opportunities when designing solutions. The fact is that many, if not most, of these solutions will be voluntary-based and motivated by the principles and values that local communities in a watershed place on their water resources. For this reason, the watershed approach must invest heavily in increasing the level of water resources knowledge, understanding, participation and commitment within our local communities.

By encouraging agencies and partners to focus staff and financial resources on prioritized geographic locations, it becomes easier to coordinate between agencies and individuals with an interest in solving water resource problems.

In the long run, all water resource concerns and the sources of those concerns must be considered and evaluated collectively. Then, agencies and local stakeholders are better positioned to efficiently focus and employ human and financial resources to find solutions that will produce measurable, sustainable results.

The process may appear complex but the overarching goals are quite simple – streamline the department's watershed planning efforts while increasing public engagement, improve targeting and resource use and increase the benefits of protecting Our Missouri Waters. To learn more about the Our Missouri Waters initiative, visit the department's website at dnr.mo.gov.

Darrick Steen is the Our Missouri Waters statewide project coordinator. Renee Bungart is director of communications for the department.

(Above) The Highway 171 bridge over Center Creek in the Spring River watershed is near Joplin, in Jasper County.
(Below) Grand Falls, on Shoal Creek in southwest Joplin, is the largest continuously flowing waterfall in Missouri, and part of the Spring River watershed.

Cool Fossil Discoveries in

Ancient life in Kansas City

by Pat Mulvany
photographs by Scott Myers

Imagine an expansive underwater playground and visualize the area that is now the central United States, including Missouri, being covered by a warm, shallow, inland sea. This was the setting for a variety of plankton, fish, sharklike fish and other animals that enjoyed this habitat during what is known as the Pennsylvanian Subperiod of the Paleozoic Era of geologic time, estimated to be 300 million years ago.

Picture the sea being connected to the open ocean that lay to the west and rivers flowing into the sea to form deltas along the shoreline that hosted coal swamps.

Envision the sea repeatedly growing and shrinking in size because of worldwide glaciation-induced changes in sea level, and because of localized up-and-down movements of Earth's crust in the central U.S., where water depth probably never exceeded 500 feet.

The incredible diversity of marine life and exceptional visibility would certainly have been a snorkeler's paradise, teeming with life. Tiny planktonic organisms passively floated or weakly swam in the water. Small invertebrates such as sponges, corals, bryozoans, snails, clams, brachiopods, worms, trilobites, crinoids, urchins and starfish lived on the sea floor. Some lived firmly attached to the bottom while others were free to move about the bottom or burrow into it.

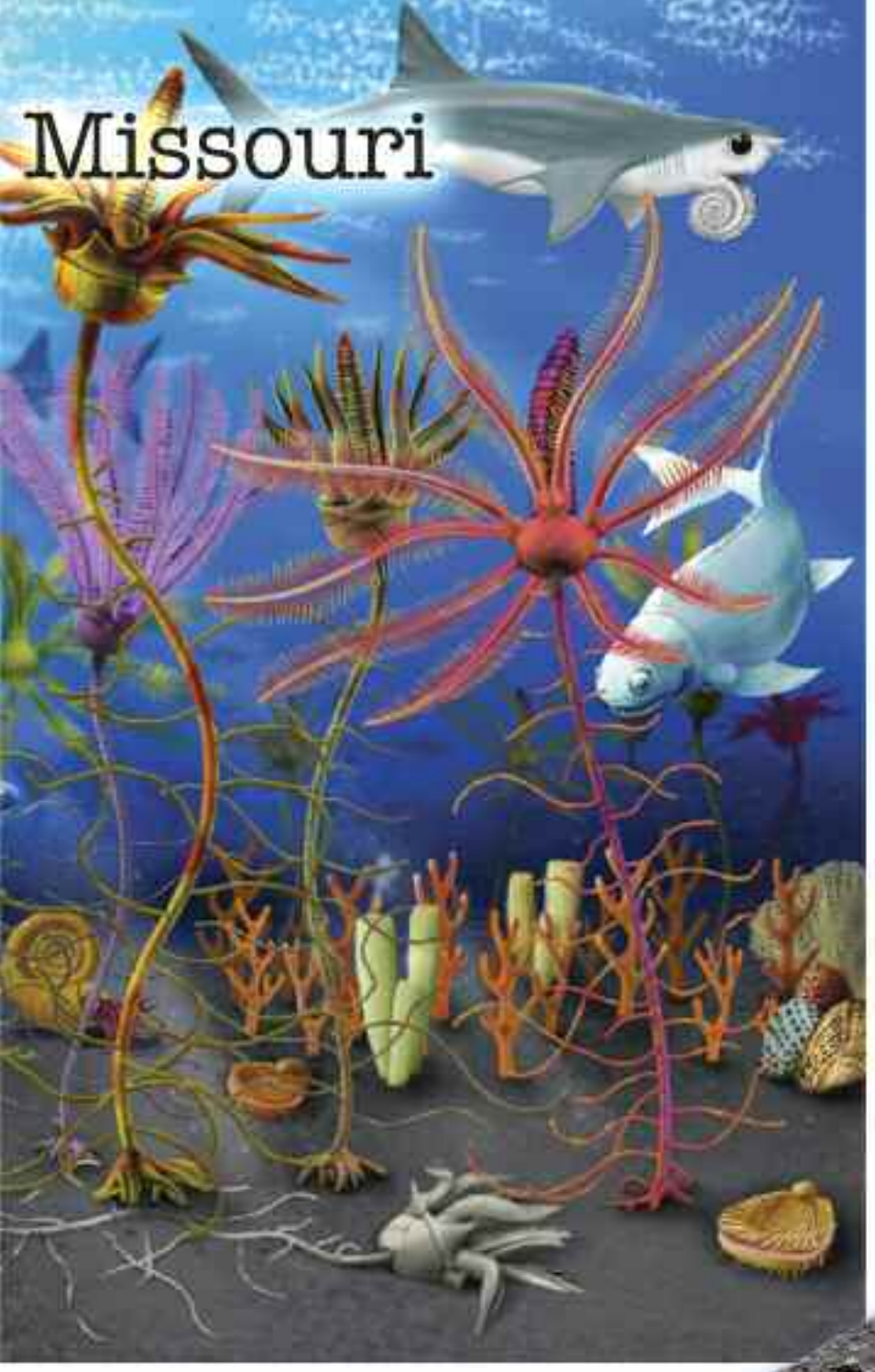
(Top, above right and below) A nautiloid, snail and brachiopod, all discovered in Westerville Limestone in the Kansas City area. In their living state, millions of years ago, all were important food items for sharklike fish.

Other invertebrates, such as shelled cephalopods similar to present-day *Nautilus* were free swimmers.

Crinoids lived attached to the sea floor by slender, flexible columns that were typically two feet long. A group of crinoids rising above the sea floor and gently swaying back and forth in the water would have been a remarkable underwater sight.

Fish also lived in the sea at this time. Fish are vertebrate animals, possessing a backbone. There were two main kinds of fish. The bony kind had skeletons made of real bone, like present-day perch. Then there were the cartilaginous or Chondrichthyes fish, whose skeletons were made entirely of cartilage rather than bone. Their only hard body parts were their teeth, fin spines and dermal denticles – the button-like and feathery projections that studded their skin.

In many ways, they resembled present-day sharklike fish that include true sharks, rays, skates and chimaeras.



Book illustration by John Babcock – *Rocks and Fossils of the Central U.S. with Special Emphasis on the Greater Kansas City Area*

(Left) Skeletal remains of a vast and strange array of creatures are entombed in the layers of rock that underlie the Kansas City area. John Babcock's original illustration will be included in an exhibit about the geologic history of the area in downtown Kansas City, beginning Oct. 1. Go to paleo.ku.edu/rocksandfossils for more information.

(Bottom left) A right-angled front tooth of a sharklike fish named *Janassa* was found in a thin shale layer of Cement City Limestone. (Bottom) This rare discovery is a fossilized fin of a sharklike fish, discovered in a layer of Stark Shale. The parallel strips of cartilage are clearly evident.
(Below) The front tooth of a sharklike fish named *Peripristis* or *Ctenoptychius* was found in Westerville Limestone.

> "… The greatest discoveries in paleontology have been made by a single stroke of the rock hammer, as a new fossil is revealed."
>
> – Richard J. Gentile, Ph.D., Professor Emeritus,
> Department of Geosciences, University of Missouri-Kansas City.

(Right) Plankton, fish, sharklike fish and other animals called Missouri home during the Pennsylvanian Subperiod of the Paleozoic Era of geologic time, estimated to be 300 million years ago. The major divisions on this geologic time scale depict geologic time 650 million years ago to the present. Divisions are arranged in chronological order with the oldest at the bottom, the most recent at the top. Geologists, paleontologists and other earth scientists use a geologic time scale to describe the timing and relationships between events that have occurred throughout Earth's history.

DNR graphic by Mark Gordon

(A) Fossilized, button-shaped dermal denticles like these covered the skin of a sharklike fish named *Petrodus*. (B) This tooth of a sharklike fish named *Campodus variabilis* was discovered in Frisbie Limestone. (C) The feathery, dermal denticle of a sharklike fish named *Listracanthus* was found in Stark Shale.

These sharklike fish were the biggest animals in the sea, and it could be said that they ruled that domain.

"Based on the size of the fossil teeth and denticles, the total body length of those Pennsylvanian sharklike fish typically ranged from less than one foot to about 20 feet," said Richard J. Gentile, Ph.D. Gentile is a Professor Emeritus from the Department of Geosciences at the University of Missouri-Kansas City.

Some Chondrichthyes had sharply cusped teeth, and presumably fed on the flesh of bony fish and other sharklike fish. It was likely a situation in which the big ones ate the little ones. Others had low-crowned teeth that were arranged to form broad crushing surfaces. They specialized in eating the myriad shelled invertebrate animals. Still others had sharp teeth toward the front of the mouth and blunt teeth toward the back of the mouth – equipped to eat just about anything. Most sharklike fish continually shed old teeth and grew new ones throughout life.

When sharklike fish died, their flesh and cartilage almost always decomposed completely. All that remained were teeth, fin spines and dermal denticles. These hard parts had a good chance of becoming fossils. Once in a while, soft body parts are found preserved in black shale.

Today, the sea that once covered Missouri is gone, but rocks deposited during the Pennsylvanian Subperiod are exposed at the surface in Kansas City and surrounding areas. Fossilized teeth and dermal denticles of the sharklike fish can be found in the rocks.

"Amateur fossil enthusiasts will spend hours carefully splitting apart slabs of black shale in the unending search for that remarkably preserved fossil or heretofore-unnamed fossil species. The greatest discoveries in paleontology have been made by a single stroke of the rock hammer, as a new fossil is revealed," said Gentile.

Time marches on and mankind now rules the region. However, one can see a Black Reef Shark and other sea creatures at the Kansas City Sea Life Aquarium. Visit their website for information at visitsealife.com/Kansas-city/. Also, plan a trip to the Missouri Department of Natural Resources' Ed Clark Museum of Missouri Geology to see corals, bryozoans, crinoids, trilobites, rocks, minerals and exhibits related to Missouri geology. Located at 111 Fairgrounds Road, the department's Division of Geology and Land Survey is open to the public from 8 a.m. to 5 p.m. weekdays. Go to dnr.mo.gov/geology/edclarkmuseum.htm for more information.

Pat Mulvany is a geologist with the Department of Natural Resources' Division of Geology and Land Survey.

About the Author

DNR photo by Hylan Beydler

Pat Mulvany grew up in the Kansas City area. At the age of seven, he became interested in all the fossils that he saw everywhere in the rocks. He spent a good portion of his childhood and teenage years collecting, dragging home and identifying fossils. Every once in a while there was the thrill of finding a sharklike fish fossil. These fossils are rare, so a person has to look and look, then look some more. Mulvany knows that persistence and patience are essential, and that fossils are often found when they are least expected. It is always a pleasant surprise to find one.

The fossils pictured in this article were collected by the author in the 1960s and 1970s. Many still reside in the rocks at Kansas City. As with any field trip, DNR reminds you to respect the rights of private property owners and ask for permission in order to access areas outside public lands, roads and rights-of way.

(D) The tooth of this sharklike fish named *Cladodus* was extracted from contact between Paola Limestone and overlying Muncie Creek Shale.
(E) This fossilized tooth came from a sharklike fish named *Petalodus destructor* and was imbedded in Bethany Falls Limestone.
(F) Pictured is a tooth from a sharklike fish named *Deltodus,* found in Westerville Limestone.
(G) This greatly enlarged photo shows the very small tooth of a sharklike fish named *Orodus*, discovered in an exposed layer of Stark Shale.

Reservoir Watchdogs

Program keeps a sharp eye on dam safety

by Kerry Cordray
photographs by Scott Myers

(Above) Dam Safety Engineer Paul Simon measures a lake level using a survey-grade GPS instrument. (Below) Chief Engineer Bob Clay points out a sinkhole above a spillway pipe at Hulen Lakes in Columbia.

"Well now, let's take a good look at this," said Bob Clay, a hint of concern in his voice.

On a fine spring day earlier this year, the chief engineer of the Missouri Department of Natural Resources' Dam and Reservoir Safety Program crouched down to peer into what looked like a small sinkhole formed around the side of a concrete culvert. The culvert was the outlet to Hulen Lake East, a seven-acre lake in a residential area of Columbia in Boone County.

No more than five minutes earlier, Clay had explained that in the program's dam inspections, about 95 percent of the dams examined passed their checkups without any safety concerns to note. Now, he and fellow dam engineer Paul Simon were snapping photographs, examining the trickle of outflow at the open end of the culvert and carefully logging readings on a global positioning probe to mark the exact position and depth of the erosion around the side of the concrete pipe.

This was a "high-hazard" dam, one of the dams that could cause a loss of life and significant property damage if it failed. Such dams get a safety inspection every two to three years. Of the 681 regulated dams statewide, 461 are high-hazard dams.

"In Missouri, dams 35 feet or more in height are regulated by state laws carried out by the Missouri Dam and Reservoir Safety Council," said Clay. "Regulated dams require permits and get regular inspections to make sure the people downstream are safe."

The dam and reservoir safety council may exempt dams from the regulations if they're mainly intended for agricultural use.

Dam failures and modern laws

In Missouri, the first state law aimed at dam regulation was passed in 1889. Called the Dams, Mills, and Electric Power Law, the law dealt only with damages caused by construction and lake formation. It didn't address the engineering or downstream safety issues related to dams.

After several U.S. dams failed in the mid- and late 1970s, including some in Missouri, President Jimmy Carter instructed the U.S. Army Corps of Engineers to investigate the problem of unsafe dams. In 1979, after the COE reported that Missouri led the nation in the number of unsafe dams, the Missouri legislature passed the state's current Dam Safety Law.

Since then, the Dam and Reservoir Safety Program has worked to fulfill Missouri law, reviewing plans and specifications for new dams, giving technical assistance to dam owners, and inspecting dams to make sure they stay safe.

Flora, fauna and fissures

During the three inspections made on this day, the men looked closely for signs that vegetation on the dams was in good shape and well-maintained.

"Keeping good grassy vegetation is crucial to avoid erosion," said Clay. "At the same time, many dams also need to have small trees or brush removed from embankments or spillways. Roots of woody plants can cause pathways for seepage."

Every dam, no matter what type, has some form of seepage. In most cases it is harmless and barely noticeable, a small amount of water that slowly permeates the dam and escapes through the foundation, the embankment, or along where foundation and embankment meet.

"We look for the location, amount and qualities of the seepage," said Clay. Cattails or other wetland plants downstream from the dam embankment are a good clue to finding seepage areas. "If sediment shows up in the dam's seepage, it may be a minor issue that needs to be watched for further change, or the sign of a problem that should be repaired right away."

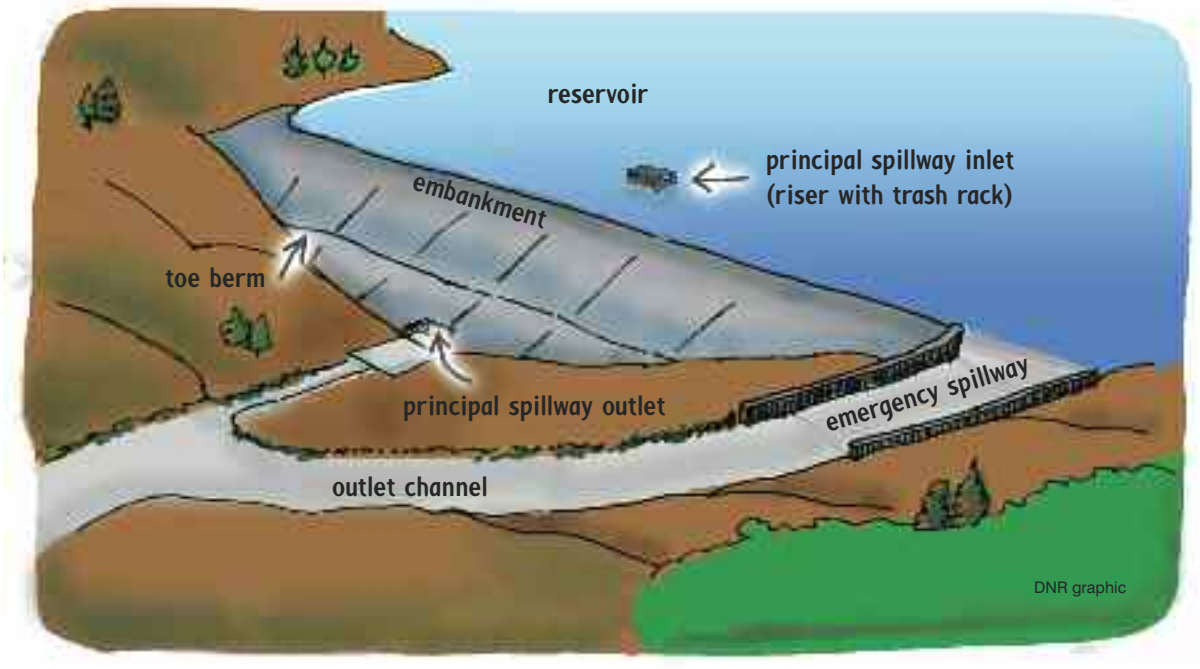
An earthen dam also may develop small structural problems such as cracks and small slides.

"We look for arc-shaped cracks on the embankment that can show that a slide or slough is beginning," Clay said. "Even small cracks can soon turn into larger problems that need emergency treatment to prevent a dam failure."

Another common source of damage is the activity of burrowing animals. On the day's run of three inspections, the men would find evidence of a beaver's activity at the top of a spillway at one dam, damming the upstream opening of the spillway and raising the lake's water level by several inches.

Clay and Simon investigate a sinkhole to determine possible causes.

Components of a Typical Earthfill Dam



Beaver dams in spillway channels restrict flow and reduce the storm water storage capacity. This adverse hydraulic effect can result in failure of the spillway or the earthen dam itself.

The Dam and Reservoir Safety Program regulates numerous dams that were constructed to store mine waste. Pictured is a barite tailings dam.

"Critters like groundhogs, muskrat and beaver are naturally attracted to dams and reservoirs, and can do a surprising amount of damage," Clay said. "Beavers plug up spillways, groundhogs usually tunnel into downstream slopes, and muskrats and beavers sometimes dig into the upstream side of a dam under the water line."

Those holes can weaken an embankment and become channels for seepage.

Emergency planning

In the last few years, staff in the department's Water Resources Center have made special efforts to help dam owners meet the emergency planning requirements of Missouri law.

"A high-hazard dam has at least ten homes or one public business in its 'inundation zone,' the area that would be flooded immediately if the dam failed," Clay explained. "Owners of high-hazard dams are required to develop and keep an emergency action plan, file it with local authorities, and be ready to follow the plan if needed."

Since 2009, department hydrologists have acquired data from new topographic scans that used aerial LIDAR (light detection and ranging) to scan areas downstream from many high-hazard dams. The data were used to develop detailed maps of dams' inundation zones. The maps and sample emergency plan materials were furnished to dam owners at workshops held around the state. This is an ongoing project that is expected to be complete in 2014. So far, more than 200 new emergency action plans have been completed. The ultimate goal is to have a plan for each regulated dam in Missouri.

At the End of the Day

At the close of the day's inspections, the tally was one Macon County dam passed with some maintenance requests, one Columbia dam with a passing grade, and another where the dam owner was required to have a private civil engineer assess the erosion problem around the outlet culvert.

"It's fortunate for the dam owner that we discovered the problem before they were faced with a later, bigger structural issue or even a catastrophic failure," Clay declared. "This was a good day's work!"

Kerry Cordray is division information officer for DNR's Water Resources Center and Soil and Water Conservation Program.

CLOSED
BUT NOT FORGOTTEN

Old Landfills and You

by Laurie A. Bobbitt

DNR photo by James Gross

Imagine the headlines, "Landfill Leaks Methane Into Nearby Homes," and "Burning Mop Alerts Esselmans." This frightening scene actually happened 14 years ago on the outskirts of a small Missouri town in Perry County.

A Missouri Department of Natural Resources investigation determined methane gas from decomposing trash in a nearby closed landfill migrated beneath a highway and into a crack in Kevin Esselman's basement floor. Apparently the flame from the gas water heater lit the methane, setting a nearby mop on fire. No one was hurt, and the incident alerted Esselman to a 4-inch flame leaping from a crack in the floor. His description was vivid: "It looked like a gas stove on full blast."

The landfill owner installed a deep trench along the side of the landfill to keep methane from migrating. Gas monitoring has proven the solution effective. As a precaution, the landfill owner purchased and razed Esselman's home, as well as another nearby residence.

Burning basements make headlines, but the sales of abandoned landfills to uninformed buyers at county tax sales do not. The buyer may think he is getting a great deal on a piece of property only to discover that it is unsuited for the desired use: to build a home or graze cattle, for example. To make matters worse, the landfill may be discharging leachate (water contaminated from contact with waste), not be properly closed, or hold other unpleasant surprises.

DNR photo by Dan Norris

(Above) Cattle trample the landfill cap and vegetative cover while drinking from leachate seeps on this rural, former landfill site in Cedar County.
(Left) Leachate with gas bubbles in Gasconade County indicates that landfill decomposition is still occurring.

Background

Since 1972, solid waste landfills in Missouri have been governed by the requirements of the Missouri Solid Waste Manage-

DNR photo by Cecilia Campbell

ment Law. The Department of Natural Resources, created in 1974, was given responsibility for permitting all landfills in the state and enforcing the Solid Waste Management Law. The department's Solid Waste Management Program regulates landfills, even after they close their gates.

During the next 40 years, industry, academia and government studied and worked with landfills, learning a great deal about waste decomposition and the movement of degradation products, such as leachate and methane gas. Laws and regulations were strengthened in order to better protect public health, safety and the environment. As a result, modern landfills are very complex in comparison to those that operated in the 1970s and 1980s.

Recently, there has been more interest in the condition of and land use near older landfills. Under a grant from the U.S. Department of Agriculture's Rural Development Utilities Program, the Solid Waste Management Program evaluated 58 such landfills between November 2010 and April 2011 and provided technical assistance to current property owners and officials in nearby rural communities.

(Top) This electrical substation in Atchison County, built adjacent to a closed landfill, poses a safety concern if methane gas from the landfill collects in its underground vaults. (Below and inset) Leachate is not far from an open well on a closed landfill in Cole County.

DNR photo by Ricardo Jones; Inset: DNR photo by Dan Norris

Evaluation Findings

Following the 58 on-site assessments, the results were tabulated and problems found were divided into seven categories:

- **Off-Site Methane Gas**
  About 3 percent of the sites were discovered to have methane gas migrating from the landfill. Due to the explosive nature of methane, this problem is the department's highest concern.
- **Off-Site Leachate**
  About 13 percent of the sites had some discharge of leachate off of the landfill. Sampling showed there was little impact to receiving waters.
- **Lack of Maintenance**
  About 91 percent of the sites were lacking some degree of proper maintenance, imperative to help prevent problems from arising.
- **Land Use Impacts**
  About 19 percent of the sites were negatively affected by the owner's improper use of the property. Improper uses include livestock grazing, row cropping, and unapproved construction work on the landfill.
- **Monitoring Deficiencies**
  Due to the age of these landfills, only six of the 58 sites were required to monitor gas or groundwater wells. All six were non-compliant in some manner, either by not maintaining or sampling the wells.
- **Public Safety Concerns**
  About 52 percent of the sites were deemed to pose a potential public safety concern. Some concerns were structures built on or near a landfill or drinking water wells installed too close to a landfill.

- **Long-Term Stewardship Issues** About 22 percent of the sites had a deficiency in required paperwork, which could cause problems for future buyers.

Follow-up

In order to address the deficiencies discovered, new fact sheets were developed and widely distributed to address maintenance, use, buying and selling of landfills. Landfill owners received reports explaining problems found at their sites and actions required to correct these deficiencies. Department staff made calls to the owners to ensure they understood the report and to answer any questions.

People living near landfills or those with drinking water wells near landfills were notified of potential problems they may encounter and how to ensure their own health and safety. Every county collector in areas containing a permitted landfill was sent a packet of information providing landfill locations and a sample letter with guidance documents to give interested buyers if a landfill is for sale.

In order to better educate the solid waste management community, including regulators, conference presentations were given to disseminate the project's findings.

Take-Home Message

People who own property that contains a closed landfill or who are thinking about purchasing one should conduct thorough research and develop a full understanding of the responsibilities and liabilities that accompany the property.

Owning a landfill does not have to be as onerous as it sounds, especially if it was well-operated, closed correctly and is properly cared for.

If you live in or wish to buy a structure near a landfill, be aware that methane gas may migrate out of older landfills without easy detection.

Take necessary precautions and install methane detectors that alert owners to the presence of methane. If you have or wish to install a well, make sure it is at least 300 feet from buried waste and is cased deep enough to prevent contamination from leachate.

For more information, visit dnr.mo.gov/env/swmp/techproj.htm.

Laurie A. Bobbitt is a technical environmental specialist in the Missouri Department of Natural Resources' Solid Waste Management Program and coordinated the program's closed rural landfill study.

(Top left) Failure to maintain wells, like this one in St. Francois County, provides a direct conduit to groundwater contamination from older, closed landfills.
(Top right) Dead deciduous trees adjacent to a Dent County landfill indicate methane gas migration.
(Above right) Trespassers or property owners have damaged the landfill's soil cap by driving ATVs on this Pulaski County site.
(Below) Although part of this Gasconade County community was developed on the fringe of an old, closed landfill, no methane gas problems have been detected to date, perhaps due to careful engineering while it was in operation.
DNR photos by Dan Norris

newsbriefs

Green Infrastructure Guide for Community Developers

The Missouri Department of Natural Resources has developed a new green infrastructure guide for municipalities and community development professionals in Missouri and the Midwest.

The Missouri Guide to Green Infrastructure: Integrating Water Quality into Municipal Operations, provides a general overview of green infrastructure for storm water and energy management, whole-life costs and the triple bottom-line benefits for social, economic and environmental interests. The guide also provides a how-to approach to site design and implementation strategies, champion projects, local codes, ordinances and policies – all in a manner that provides a level playing field and equitable incentives for developers and taxpayers.

As Missouri and the rest of the country move toward environmentally compatible approaches to infrastructure planning, the Missouri Guide to Green Infrastructure will provide municipalities and regions with a roadmap to implement sustainable storm water management practices to improve water quality, help relax financial burdens and provide new recreational opportunities.

The Missouri Guide to Green Infrastructure: Integrating Water Quality into Municipal Operations is available online at dnr.mo.gov/env/wpp/stormwater/mo-gi-guide.htm.

Energy Director Joins Regional Energy Board

Llona C. Weiss, director of the department's Division of Energy, was selected to serve on the board of directors for the Midwest Energy Efficiency Alliance until 2013.

The MEEA raises awareness, facilitates energy-efficiency programs and strengthens energy policy across the Midwest region.

The board of directors will provide guidance as MEEA continues to grow and provide expanded services across its 13-state region. In total, nearly $1.2 billion in rate-payer dollars were spent on energy efficiency in 2011, and that number is expected to increase to $1.5 billion by 2015. MEEA's board will provide direction as best practices and new technologies are promoted in the Midwest.

DNR Launches ePermitting

The Department of Natural Resources unveiled its ePermitting system for land disturbance permits. Those seeking one of the most common permits from the Missouri Department of Natural Resources will be able to do so online in a fraction of the traditional permit application time. Department of Natural Resources Director Sara Parker Pauley announced on June 22 that ePermitting was up and running.

"This improvement in efficiency means builders, contractors and developers can get permits in minutes instead of weeks," Pauley said. "And even with the simplification, it still offers the same level of environmental protection as before."

A land disturbance permit is required for any project that results in the disturbance of one acre of land or more. The purpose of the permit is to make sure steps are taken by the permit holder to prevent erosion from the site from polluting local waterways.

The department issued 829 land disturbance permits in 2011. Between 2007 and 2011, the number of such permits issued ranged from 829 to 2,365. To date, in 2012, the department has issued nearly 1,400 permits.

The first ePermit was issued to Chesterfield-based McBride & Son Homes for its Stone Meadows subdivision in Wentzville.

The department has developed videos designed to help permit seekers with the online process. A link on the department's online home page, dnr.mo.gov, will take visitors to the ePermitting page.

Those wishing personal assistance with ePermitting can visit any of the department's five regional offices or the Lewis and Clark State Office Building in Jefferson City.

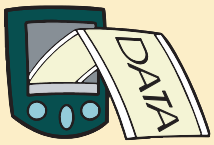
Discover Careers During Science Week

The Department of Natural Resources will partner with the American Geological Institute and others during Earth Science Week, Oct. 14-20, to engage youngsters and the public in learning about careers in the Earth sciences. Events will encourage people everywhere to explore the natural world and learn about the geosciences. "Discovering Careers in the Earth Sciences," this year's theme, will help explain how geoscientists gather and interpret data about the Earth and other planets.

The department's Division of Geology and Land Survey participates during Earth Science Week by sharing information with children and adults about how earth sciences play a fundamental role in the health, safety and welfare of all Missourians. This year marks the first annual National Geologic Mapping Day. On Friday, Oct. 19, staff will share information about the benefits of geologic maps.

Additionally, the department will mark the third annual National Fossil Day, Wednesday, Oct. 17, with special exhibits in the Ed Clark Museum of Missouri Geology. Sponsored by the National Park Service and the American Geological Institute, National Fossil Day promotes public awareness and stewardship of fossils, as well as an appreciation of their scientific and educational value. On National Fossil Day, visitors to the department's museum in Rolla will receive a crinoid fossil stem. The crinoid is Missouri's official state fossil. For more information about Earth Science Week activities, visit dnr.mo.gov/geology.

Geothermal Missouri Grant Project – Status



Geologists with the Department of Natural Resources' Division of Geology and Land Survey are at the mid-point of a three year federally funded project to provide information about Missouri's renewable geothermal resources. Funding in the amount of $300,000 from the U.S. Department of Energy, dedicated to the State Geothermal Data project and organized by the Association of American State Geologists, continues to enable staff to identify and characterize the state's renewable geothermal energy resources.

Data being compiled include: location information for water wells, oil and gas wells, ground-source heat pumps, rock core and cuttings. Additionally, temperature data is being collected from oil and gas production, existing deep municipal water wells and wells currently under construction.

Geologic maps are the most fundamental source of geologic information for the earth sciences. Geology affects everything from ecology to highway construction. Bedrock maps are used for exploration and development of mineral, fuel and groundwater resources and contribute to our knowledge of the likelihood of damage from earthquakes, landslides or sinkhole collapse. This national collaboration of state and federal agencies, universities and industry, has the potential to reshape America's energy landscape well into the 21st century. Learn more about this project and see data presently available at dnr.mo.gov/geology/geosrv/geores/geothermal.htm

environmental notes

A Back-to-School List

Summer is over and the school year is now in full swing. In addition, October marks the start of Children's Health Month. As fall begins, let's examine some things we can do for our kids to make their environment a better, healthier place to learn, play and live.

- **On the way to school:** School buses in the U.S. collectively travel almost 4 billion miles each school year. With that many miles under their (fan) belts, they are already putting tons of exhaust and particulate matter into the air. Why not consider urging your school to create no-idle zones – not only for buses, but carpool lines, as well. Besides saving on fuel, vehicle exhaust can be especially harmful to children because of their faster breathing rate and still-developing lungs.
- **In the classroom:** With fall classes underway, most parents have made their yearly supply runs, picking up paper, notebooks, binders, pens and assorted specific class/teacher requests. Before heading to the store next fall or for the second semester, consider browsing the leftovers that survived the first semester or school year. You might have unused pens, pencils, binders, loose leaf and other items lying around the house that weren't used. In addition, if you do still need to run out for some last-minute class requests, consider items that are made of recycled materials or that can be used for more than one year or semester.
- **Get out!:** Finally, do what you can to encourage children to get outdoors. It could be anything from a game of Frisbee in the yard with neighbors or, if possible in your area, walking to school instead of driving. In addition, take steps to help your children connect with nature. Connecting children with nature encourages physical activity that reduces obesity and has been shown to improve a child's mental abilities and sense of well-being. A long-term benefit of helping establish your kids' link to the outdoors builds a lifelong understanding and concern for the care of our natural resources.

On the way to school, in the classroom or outside, let's work together to keep the long-term health and happiness of our children, young friends and neighbors in mind. They might just pass it on.

Battle of Island Mound State Historic Site Opens

Battle of Island Mound State Historic Site, Missouri's newest state park facility, was dedicated and opened to the public in October. Its quiet pastoral setting in rural Bates County is in contrast to the battle that occurred here in 1862 – a battle that marked the first time black soldiers engaged in combat during the Civil War.

In the fall of 1862, two battalions of the First Kansas Colored Infantry were sent into Bates County, which had become a haven for guerrillas. The soldiers operated out of a home they called "Fort Africa." On Oct. 29, 1862, 30 black troops were ambushed by some 130 rebel horsemen near a low hill known as Island Mound. The battle was a significant milestone in the history of the Civil War.

The 40-acre historic site, which was dedicated 150 years after the original Battle of Island Mound, preserves the site of Fort Africa. The site interprets the battle through a kiosk with information and displays and a short walking trail with wayside exhibits. The day-use park, located eight miles southwest of Butler in Bates County, also offers a picnic area.

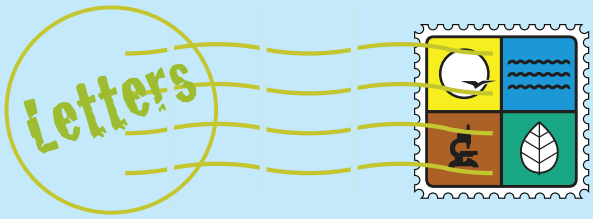
$12 Million Low-interest Loan for Jefferson County

The Missouri Department of Natural Resources has awarded the Northeast Public Sewer District in Jefferson County a $12 million low-interest loan for wastewater treatment projects.

The district will use the loan for a multi-phased project intended to regionalize the service area by eliminating seven of the district's wastewater treatment plants and redirecting the flows to the Saline Creek Regional Wastewater Treatment Plant.

Another purpose of the project is to eliminate a major source of inflow and infiltration, storm water runoff and groundwater that make their way into sanitary sewer pipes and get treated, unnecessarily, at wastewater treatment plants.

Funding for the loan comes from the Clean Water State Revolving Fund. The fund provides significant funding to assist communities with their wastewater infrastructure needs. A portion of the funding will be targeted toward green infrastructure, wastewater and energy efficiency, and environmentally innovative projects. This funding will help the district protect residents and the environment by making necessary wastewater improvements.



Thank you, as always, for an excellent, educational and entertaining publication in the form of *Missouri Resources*. On page 15 of the Spring/Summer issue, you have an article about Navy showers. I should begin by saying that I am one who – even when taking standard showers with the water on all the time – my family always asks, "Are you done already?" So, I seem to take relatively short showers anyway.

However, I'm not sure how many converts you may glean for taking "Navy showers," at least in the long run. As a Navy retiree myself (my comments are mine alone and do not reflect any official position), I will say that although we were required onboard to take the sort of shower you describe in your article, sailors were always glad to return to port where they might enjoy a "continuous" shower ashore!

(The next time I take a shower, I think I will leave the plug in the tub, and see just how much water I use. Your article is definitely thought provoking.)

David S. Durbin
St. Louis

Did I miss it inside the magazine? I come from a large group of textile and fabric lovers. How dare you tease us with the cover showing the Watkins Woolen Mill without anything about exactly where it is, tours, or other great information?

Carole Splater
Crestwood

Editor's Note:
Unfortunately, with 85 state parks and historic sites and only three issues of Missouri Resources *each year, the coverage does get spread out quite a bit. We sent Carole some back issues that included three stories on Watkins Woolen Mill State Historic Site that ran in Winter 2007, Summer 2002 and Summer 2001.*

Great article by Dalena Hardy about Whiteman AFB ("Operation Efficiency," Spring/Summer 2012). However, you missed an opportunity to tell the story to Missourians that the 131st Bomb Wing, Missouri Air National Guard, also flies the B-2 Bomber. They also are a full partner with the 509th Bomb Wing in the energy-saving programs.

Col. Ken Schroer, USAF (Ret)
St. Charles

In the Spring/Summer 2012 issue, there was an article called "Fountains of Truth." A notation on page 10 states that a stream gauge is located on the Meramec River in Montauk State Park. I can tell you, as a long-time visitor and fisherman at Montauk, that it is the headwaters of the Current River, not the Meramec, that has its origins at Montauk State Park. One of the four major water sources for the Meramec River is Maramec Spring, the fifth-largest spring in Missouri, near St. James. I was surprised by the oversight. Thanks for a great publication!

Darrell DuBois
Chesterfield

Editor's Note:
Darrell is correct, as several other readers pointed out – the "Fountains of Truth" story included a photo that was mislabeled during editing. The stream gauge in question is on the Current River. Our apologies and thanks to those who took the time to alert us to the error.

Letters intended for publication should be addressed to "Letters," *Missouri Resources,* PO Box 176, Jefferson City, MO 65102-0176 or faxed to (573) 522-6262, attention: "Letters." Please include your name, address and daytime phone number. Space may require us to edit your letter. You also can email *Missouri Resources* staff at moresdnr@dnr.mo.gov.

Missouri Receives DOE Grant

Missouri was one of 22 states selected to receive a competitive State Energy Program grant from the U.S. Department of Energy. The awards are part of the Energy Department's effort to reduce energy costs in homes and buildings, create jobs, and boost domestic manufacturing of energy-saving technology.

The department's Division of Energy, in partnership with the Office of Administration's Division of Facilities Management, will use $715,000 over a three-year period to reinvigorate Missouri's State Facilities Energy Conservation Program.

In 2009, Gov. Jay Nixon signed Executive Order 09-18, which required state agencies to develop policies that will result in reductions of energy consumption by two percent per year over the next 10 years.

Activities funded by the grant will include assessing practices for retrofitting state government buildings; identifying barriers to building energy retrofits; implementing energy-efficient strategies; and developing energy training for both maintenance staff and state employees.

"Our goal for the State Facilities Energy Conservation Program is to achieve 20 percent or greater energy savings in at least half of state-owned and operated buildings," said Llona Weiss, director of the Division of Energy.

Stay Connected in Missouri State Parks

It's great to get away from it all in Missouri state parks but it's also nice to be connected if you want to be. Now you can have the best of both worlds. Missouri State Parks offers free wireless Internet access in more than half of its 40 state park campgrounds. Most parks have full coverage in the campgrounds while others have designated hotspots with coverage. Signs are posted in the campgrounds indicating where Internet access is located.

Complementary Wi-Fi is just one of the amenities offered in Missouri's state park campgrounds. Check with your favorite state park campground to see if it is one where you can stay in touch and relax at the same time.

Stream Team Notebook

Watershed Coalition Hosts 319 Grant Summit

Stream Teams and 319 Nonpoint Source Grant recipients from all over the state of Missouri gathered in Branson June 12-13 for a summit meeting to share information and celebrate successes. The Section 319 Nonpoint Source Management Program provides federal funding to states in order to assist them in mitigating nonpoint source pollution. Holly Neill, Executive Director of the Missouri Stream Team Watershed Coalition, was responsible for planning and organizing the event.

Neill planned the summit in order to showcase successful 319 grant programs and publications that have occurred in different parts of the state.

"It was such a pleasure to help host this event that brought together individuals from many different watersheds across the state doing wonderful work to protect our water resources," Neill said. "We hope the summit provided an opportunity for participants to share, learn, and be inspired for continued success in their watershed."

DNR photo by Susan Higgins

Holly Neill welcomes 319 grant recipients to the Dewey Short Visitor Center on Table Rock Lake.

Attendees were encouraged to utilize, emulate, and implement these efforts in their local watershed without having to "reinvent the wheel" for each project. A reception at the new Army Corps of Engineers' Dewey Short Visitor Center on Table Rock Lake allowed the group to tour the new LEED™ (Leadership in Energy and Environmental Design) Gold-certified facility.

On June 13, presenters discussed lessons learned and offered suggestions to overcome challenges. Several grant recipients gave presentations showcasing their works in progress, while others documented their successes. Department of Natural Resources Director Sara Parker Pauley gave the keynote address after being presented with the professional "Water Warrior" award for 2012. The award was presented by Peter Herschend, Chairman of the Board of Directors for the Ozarks Water Watch Foundation. The 319 celebration was held in conjunction with Water Watch Week June 8-16, a series of planned events to emphasize the importance of clean water in the Ozarks.

MISSOURI STREAM TEAM

Time Exposures

White River Valley Historical Society photo

In 1913, Missouri's first hydroelectric dam went into service in Forsyth. At the time of its design, Powersite Dam was the largest concrete dam of its kind, housing four generators with space for five more if needed. The image above shows construction progress on Powersite Dam in September 1912.

Work on the dam began in 1910, creating what is now Lake Taneycomo. As costs exceeded the original budget, construction continued while financing was secured from New York banker Henry Doherty, owner of the fledgling Empire Electric Co. With Doherty's support, the dam was completed in 1913 and operated as the Ozark Power and Water Co. until it merged with Empire Electric in 1927.

Originally a warm water lake, Lake Taneycomo became a cold water lake in 1958 after the construction of Table Rock Dam. Today, the lake hosts some of the finest trout fishing in the world.

Send your photo to "Time Exposures," c/o Missouri Resources, PO Box 176, Jefferson City, MO 65102-0176. Pre-1970 environmental and natural resource photos from Missouri will be considered. Please include date, location, description and any related historic details that might be of interest to our readers.

Database Shows Abandoned Underground Coal Mines

As part of a continuing effort to protect citizens and expand its existing database of abandoned underground coal mines, the Missouri Department of Natural Resources' Division of Geology and Land Survey created a Missouri Mine Maps website that contains the complete inventory of mine maps. Commodity, location, mine name, map date and other pertinent information is available on the site. The site also contains low-resolution images of maps that are available in the pilot project areas.

U.S. Department of the Interior Office of Surface Mining (OSM) funding enabled division staff to acquire maps from private collections, city halls, county courthouses, historical societies, libraries and other sources for scanning and entering into the state's Mine Map Repository.

The division's Geological Survey Program is the official Missouri Mine Map Repository, established by the State Legislature in 1993 for the purposes of public safety and protection of property. It houses more than 2,000 maps of underground mines containing various mineral commodities.

It is important to know as much as possible about past underground operations for the safe development of our state. For example, the department assisted following the May 22, 2011 Joplin tornado, by identifying historic underground lead and zinc mines. This enabled city and state officials to appropriately locate temporary waste storage sites. Additional maps and functionality will be added as the project progresses. Go to dnr.mo.gov/geology/geosrv/geores/minemaps.htm.

Well Online Form Submittal System

The department is pleased to announce the availability of the Well Online Form Submittal (WOLFS) system – a new Web resource for monitoring well contractors who wish to electronically submit monitoring well certification and registration forms and pay associated fees. This new system is expected to be significantly more efficient for staff and monitoring well contractors. The WOLFS system will verify that the well construction or plugging meets Missouri Well Construction Rules requirements. Records submitted using WOLFS will be certified or registered immediately upon payment. WOLFS is online at dnr.mo.gov/mowells/ and a fact sheet is available to assist those who use the system at dnr.mo.gov/pubs/pub2440.pdf.

For news releases on the Web, visit dnr.mo.gov/newsrel/.

For a complete listing of the department's upcoming meetings, hearings and events, visit the department's online calendar at dnr.mo.gov/calendar/search.do.

Looking for a job in natural resources? Go to dnr.mo.gov/hr/.

Resource Honor Roll **Pembroke Hill High School**

A five-member team of high school students from Pembroke Hill High School beat out more than 50 other teams to win the 2012 Canon Envirothon, a week-long environmental education competition sponsored by Canon U.S.A. Inc. This was Pembroke Hill's fourth trip to the Canon Envirothon and the first time a Missouri team has captured first place honors. Pembroke Hill is from Jackson County.

The team advanced to the North American finals of the competition by winning their regional competition and the state event. The 55 teams in the North American competition represented 45 U.S. states, nine Canadian provinces and one Canadian territory. The Pembroke Hill team members are Hosain Ghassemi, Wanda Czerwinski, Riley Sloan, Jeffrey Rubel and Ryan Hrinya (left to right, photo). Team advisors are SueAnn and Richard Wright. Each student received a $5,000 scholarship, for a team total of $25,000 in Canon scholarships.

Teams test their knowledge on five areas including soils, wildlife, forestry, aquatics and a current environmental issue. For 2012, the issue was "Going Green with Low Impact Development Technologies to Reduce Nonpoint Source Pollution." Additionally, the students gave an oral presentation to a panel of judges and received a first place award for that event.

"We're extremely proud of the Pembroke Hill team and the effort they put forward to win this event," said Judy Stinson, co-chair of the Missouri Envirothon, and environmental education specialist with the Missouri Department of Natural Resources' Soil and Water Conservation Program. "To see them win just shows the commitment and dedication these students have made to the Envirothon program."

Canon Envirothon photo

Pembroke Hill High School 2012 Envirothon team

Sponsors for the Missouri Envirothon include the Missouri Department of Natural Resources, the Missouri Association of Soil and Water Conservation Districts, local soil and water conservation districts, the Missouri Soil and Water Conservation Districts Employee Association, the Missouri Department of Conservation, the Natural Resources Conservation Service, the University of Missouri Extension and the Show-Me Chapter of the Soil and Water Conservation Society.

Rock Matters

Iron Ore

Iron ore was commercially mined in Missouri from 1815 to 2001, with potential for new mining to begin again. The primary use for Missouri iron ores has been steel production, but they have many other purposes.

DNR photos by Mark Gordon

Iron ore in Missouri comprises several minerals that fall within the family of iron oxides, with varying ratios of iron and oxygen. Iron mining near the towns of Pilot Knob (Iron Co.) and Iron Mountain (St. Francois Co.) led to the beginning of the Missouri-Pacific railroad system.

Iron oxide minerals are not only found in mines, they can be found in small concentrations throughout the state. Some mineral collectors specialize in Missouri iron minerals. The primary types of iron ore that occur in Missouri are listed here, from lowest to highest in iron content.

Limonite – a mixture of iron, oxygen and hydroxide. Limonite was used as an iron ore and as a source of yellow pigment. Scattered pieces of limonite can be found throughout the state and especially in southern Missouri. Limonite ores were heavily mined until 1900, with some production as late as the 1960s.

Hematite – varies from red and earthy to gray and shiny; crystals look like shiny gray plates. Hematite is useful as a red pigment for items such as cosmetics. The largest hematite mine in Missouri was Iron Mountain, which was mined almost continuously from 1836 to 1966.

Magnetite – a dark gray to black iron, magnetic mineral excellent for steel production; its crystals resemble shiny black pyramids. Washington County's Pea Ridge Mine was the largest producer of magnetite ore in Missouri and has the potential to produce more iron.

Southeast Missouri is home to a large iron ore district. Smaller deposits are scattered throughout the state. Native Americans used the minerals for pigments. In addition to use in steel production, iron ores have been used to remove sulfur from coal, to make high-power magnets for industrial use, for water purification systems, to make concrete denser for bridge pier construction and as red, black and yellow pigments.

resources to explore

Missouri TRAILS

by Sue Holst

If you ask just about anyone for a feature that stands out in a Missouri state park, you will likely get an answer involving trails.

The dictionary defines a trail as a simple path or track. But a trail can be so much more. Trails can take you to incredible places, such as the top of a waterfall or a mountain's summit for a tremendous vista. They can transport you to another time as you follow the path of your ancestors walking across a Civil War battlefield. Trails can be just right for a leisurely stroll or the perfect place to raise your heartbeat on a strenuous hike up a hill.

Missouri's state park system considers trails one of its signature features and boasts more than 230 trails in 58 state parks and historic sites. With that many trails, it is inevitable that you will be able to find the perfect one for you and whatever adventure you seek that day.

DNR photos by Scott Myers

(Above) Whispering Pines Trail in Hawn State Park is considered by many to be one of the best hiking and backpacking trails in the state. (Right) Mudlick Trail at Sam A. Baker State Park takes riders through some of the most significant, undisturbed landscapes in Missouri.

"Whichever trail you choose, the adventure begins as soon as you step off the parking lot and take your first step on the trail," said Bill Bryan, director of Missouri State Parks, a division of the Missouri Depart-

ment of Natural Resources. “I love trails because each visit is an adventure and I love seeing what’s around the next bend.”

Everyone may have a different reason but here are the Top 10 Reasons People Love Trails:

The Top 10 Reasons People Love Trails

- There are trails for everyone’s interests, including walking, hiking, backpacking, bicycling, mountain biking, horseback riding, or using all-terrain vehicles.
- There are trails for people of all abilities, from walking trails perfect for young children or people using mobility devices to rugged backpacking trails for the most experienced hikers and mountain bikers.
- There is no cost to use a state park trail and equipment can be as inexpensive as a good pair of walking shoes.
- You can spend as much or as little time as you want on a trail.
- Trails provide access to parts of the state park system that cannot be experienced any other way.
- Using trails is a healthy way to exercise without being indoors.
- Trails are a good way for people of all ages to reconnect with and explore nature any time of the year.
- Being outside on a trail is a good way to step away from today’s hectic lifestyle and relieve stress.
- They are an easy and enjoyable way to learn about Missouri’s plants, animals and geology, and discover its history.
- Trails are perfect places to make new memories with your friends and family.

With so many trails and so many reasons, it will be easy to find a favorite trail. For Bryan, the trail that stands out is the Taum Sauk Section of the Ozark Trail between Johnson’s Shut-Ins State Park and Taum Sauk Mountain State Park. He describes it as “epic” with “awesome scenery” and a “formidable terrain.”

Others may prefer a more level terrain, such as the 240-mile Katy Trail State Park, which follows a former railroad corridor across much of the state. Considered the longest developed rail-to-trail in the nation, this trail draws hikers and bicyclists from across the United States to experience Missouri’s varied landscapes and many of its quaint communities.

Mountain bikers may choose the Grotpeter Trail at Castlewood State Park because of the varied routes and challenging terrain. Another popular mountain biking trail is the 10.25-mile White River Valley Trail System in Table Rock State Park. This new trail features four different loops, each with different characteristics and challenges.

For off-road vehicle enthusiasts, two state parks offer opportunities for various rides, including trails and open riding areas. Finger Lakes State Park offers trails for all-terrain vehicles and motorcycle enthusiasts, and St. Joe State Park offers one of the largest and most popular ORV riding areas in the Midwest.

Equestrian users can explore Missouri state parks from the back of a horse, and there are numerous trails to provide that opportunity. One of the most popular is the 11.25-mile Cuivre River Trail at Cuivre River State Park, which travels through much of the Big Sugar Creek Wild Area. Another favorite is the Mudlick Trail at Sam A. Baker State Park with its impressive views of the St. Francois Mountains.

Hiking remains one of the most popular trail activities and the choice of hiking trails is plentiful. Trails range from simple paths to rugged routes that lead to impressive views. A trail experience can be just for the pleasure of being outdoors or for learning

DNR photo by Christy Pick

DNR photo by Lauren Stroer

(Above) The .40 mile-long Wildflower Trail at Mastodon State Park takes visitors to the Kimmswick Bone Bed, where evidence of the coexistence of American mastodons and humans was first discovered. (Below) Route 66 State Park has four trails available for hiking, horseback riding and cycling.

DNR photo by Scott Myers

(Above) The Gans Creek Wild Area Trail System at Rock Bridge Memorial State Park has 8.5 miles of trails available for hikers and equestrians. (Below) There are many trails in Missouri State Parks that are open to mountain biking, like the Kelley Branch Trail at Finger Lakes State Park near Columbia. With more than 230 trails available in the Missouri State Parks system, there is a trail available for almost any adventure.

about the area's abundant cultural and natural features. The Osage Trail at Clark's Hill/Norton State Historic Site takes you to the hill where William Clark made observations during the Lewis and Clark Expedition in June 1804.

The Boardwalk Trail at Big Oak Tree State Park takes you into the heart of an old-growth bottomland forest and swamp that once covered Missouri's Bootheel.

To help you find the perfect trail, Missouri State Parks is publishing a new book called "Trails of Missouri State Parks." The book is the result of a comprehensive two-year survey of all state park trails. The full-color book includes a description of more than 230 trails, including number of miles, designated trailheads, special features, natural obstacles, images, photographs, GPS coordinates, maps, and connecting trails. In addition to trails in 58 state parks and historic sites, the book includes information on separate sections on the Katy Trail State Park and the Ozark Trail. Additional information is provided on each state park and historic site, natural and wild areas, trail etiquette, and tips to make any trail experience safe and enjoyable.

The Missouri state park system has been developing trails since it was established 95 years ago. This publication is the first comprehensive guide to those trails. "Trails are vital to any state park experience. This guide will make it easier for our users to choose a perfect trail for them and begin their own state park trail adventure," Bryan said.

For more information about ordering the new "Trails of Missouri State Parks" book, visit mostateparks.com.

Sue Holst is a writer for Missouri State Parks, a division of the Missouri Department of Natural Resources.

DNR photo by Lauren Stroer

Simple Steps to Winter Energy Efficiency

by Angie Morfeld

The winter season is fast approaching the Show-Me State, and you know what that means: shorter days, colder temperatures, inclement weather. And higher utility bills? Not necessarily, according to the Missouri Department of Natural Resources' Division of Energy.

If the thought of a return visit from Old Man Winter has you dreading your utility bills, the Division of Energy has a few simple efficiency tips that can reduce those bills and lessen the burden of this not-always-welcome visitor.

The U.S. Department of Energy estimates 22 percent of the country's energy is used residentially, with the average single family home accumulating $2,200 in energy bills annually. But it doesn't have to be that way.

"Every person has the potential to save energy in their home," said Llona Weiss, director of the Division of Energy. "Small steps can lead to big savings."

Here are a few simple energy-saving measures you can take this winter to set your home on a path to becoming more energy efficient:

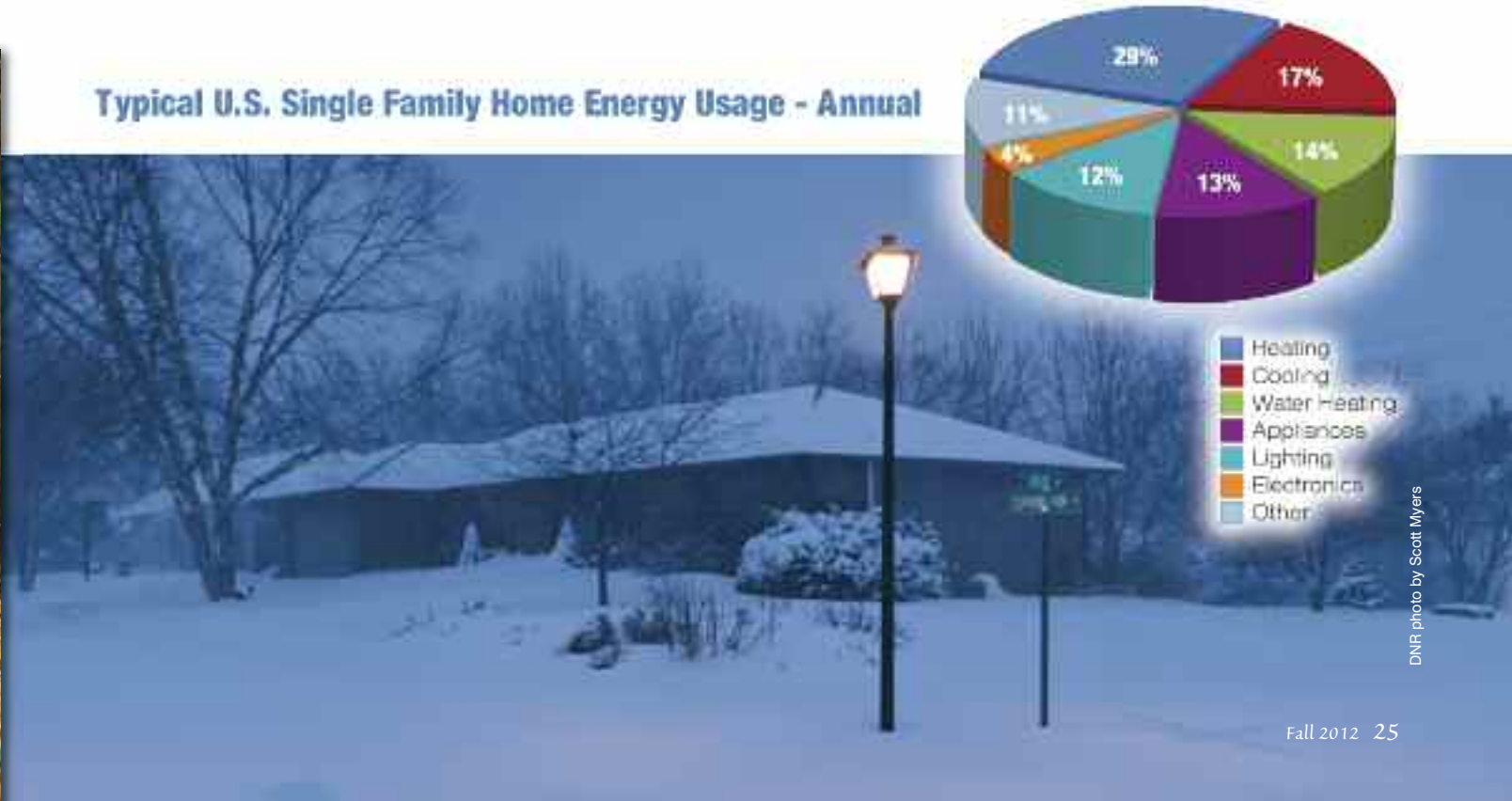
- Turn your thermostat down when you leave for the day and before you go to bed at night to reduce heating costs.
- To reduce air leaks, caulk around window frames and locations where plumbing, electrical wires or duct work penetrates through walls, ceilings or floors.
- Install foam gaskets behind outlet covers and switch plates to reduce air leaks.
- Clean or replace furnace filters once a month or as recommended by the manufacturer.
- Inspect your attic to see how much insulation is present. Approximately 13 inches of fiberglass batting and loose-fill fiberglass insulation (or 10 inches of loose-fill cellulose) is needed to achieve the recommended minimum R-38 rating for Missouri.
- Add weather stripping and sweeps to doors to help reduce air leaks.

"As you can see, you don't have to invest a lot of time or money to realize energy efficiency," Weiss said. "Just a few minor adjustments can reduce the amount of energy needed in your home."

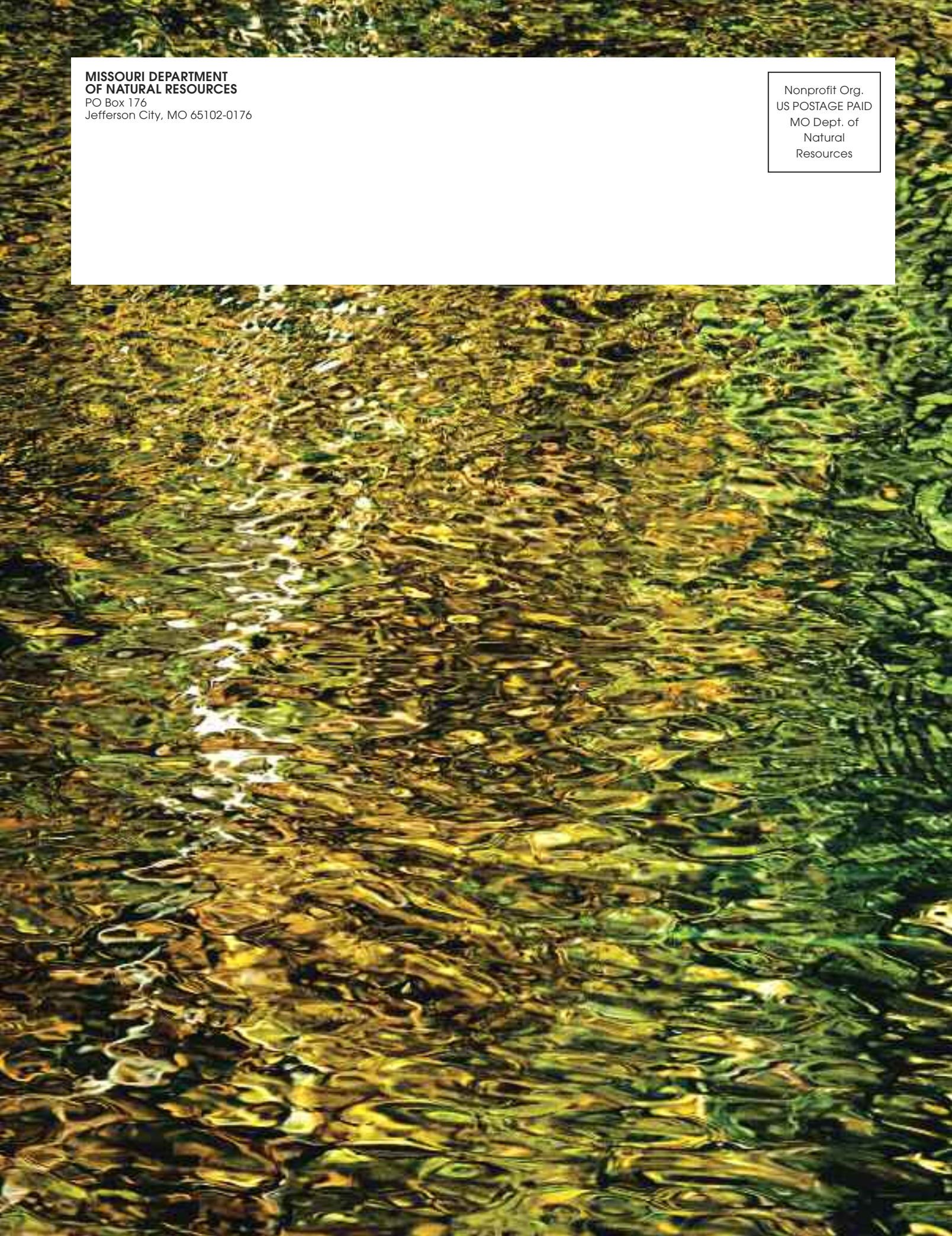
Though you may not be able to keep Old Man Winter from visiting this year, you can at least endure his stay comfortably and with a few more dollars in your pocket. For more tips on saving energy in your home year-round, visit energysavers.gov.

For more information and to find out about a comprehensive energy audit of your home, please go to dnr.mo.gov/energy/residential/homeenergyaudits.htm.

Angie Morfeld is the information officer for the Department of Natural Resources' Division of Energy.



DNR photo by Scott Myers



MISSOURI DEPARTMENT
OF NATURAL RESOURCES
PO Box 176
Jefferson City, MO 65102-0176